Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application. Please amend Claims 24, 51, and 54 as indicated in the following Listing of Claims.

Listing of Claims

1-10. (Canceled).

11. (Previously presented) A process to produce a catalyst composition comprising:

contacting a catalyst precursor with at least one organometal compound and at least one organoaluminum compound;

wherein the catalyst precursor comprises at least one treated solid oxide compound and at least one alpha olefin;

wherein the at least one treated solid oxide comprises a contact product of at least one solid oxide compound, at least one electron-withdrawing anion source compound, and optionally, at least one metal salt compound;

wherein the organometal compound has the following general formula:

$$(X^1)(X^2)(X^3)(X^4)M^1$$

wherein M^1 is selected from titanium, zirconium, or hafnium;

wherein (X^1) and (X^2) are independently selected from cyclopentadienyls, indenyls, fluorenyls, substituted cyclopentadienyls, substituted indenyls, or substituted fluorenyls;

wherein substituents on the substituted cyclopentadienyls, substituted indenyls, and substituted fluorenyls of (X^1) and (X^2) are selected from aliphatic groups,

cyclic groups, combinations of aliphatic and cyclic groups, silyl groups, alkyl halide groups, halides, organometallic groups, phosphorus groups, nitrogen groups, silicon, phosphorus, boron, germanium, or hydrogen;

wherein at least one substituent on (X^1) and (X^2) is a bridging group which connects (X^1) and (X^2);

wherein (X^3) and (X^4) are independently selected from halides, aliphatic groups, substituted aliphatic groups, cyclic groups, substituted cyclic groups, combinations of aliphatic groups and cyclic groups, combinations of substituted aliphatic groups and cyclic groups, combinations of aliphatic groups and substituted cyclic groups, combinations of substituted aliphatic groups and substituted cyclic groups, amido groups, substituted amido groups, phosphido groups, substituted phosphido groups, alkyloxide groups, substituted alkyloxide groups, aryloxide groups, substituted aryloxide groups, organometallic groups, or substituted organometallic groups; and

wherein the organoaluminum compound has the following general formula:

$$\mathbf{A1(X^5)_n(X^6)_{3-n}}$$

wherein (X^5) is a hydrocarbyl having from 1-20 carbon atoms;

wherein (X^6) is a halide, hydride, or alkoxide; and

wherein "n" is a number from 1 to 3 inclusive.

12. (Previously presented) A process to produce a catalyst composition comprising:

contacting a catalyst precursor comprising a chlorided, zinc-containing alumina and propylene with at least one organometal compound selected from rac-dimethylsilybis (1-indenyl) zirconium dichloride, rac-1,2-ethanediylbis(1-indenyl)zirconium dichloride, or rac-dimethylsilybis (2-methyl-l-indenyl) zirconium dichloride and at least one organoaluminum compound selected from triethylaluminum or triisobutylaluminum.

13. (Previously presented) A process for producing a catalyst composition comprising simultaneously contacting at least one treated solid oxide compound, at least one organometal compound, at least one organoaluminum compound, and at least one alpha olefin;

wherein the treated solid oxide compound is produced by a process comprising: a) contacting at least one solid oxide compound with at least one electron-withdrawing anion source compound; b) optionally, also contacting the solid oxide compound with at least one metal salt compound; and c) calcining the solid oxide compound before, during, or after contacting the electron-withdrawing anion source compound or the metal salt compound to produce the treated solid oxide compound;

wherein the organometal compound has the following general formula:

$$(X^1)(X^2)(X^3)(X^4)M^1$$

wherein M^1 is selected from titanium, zirconium, or hafnium;

wherein (X^1) and (X^2) are independently selected from cyclopentadienyls, indenyls, fluorenyls, substituted cyclopentadienyls, substituted indenyls, or substituted fluorenyls;

wherein substituents on the substituted cyclopentadienyls, substituted indenyls, and substituted fluorenyls of (X^1) and (X^2) are selected from aliphatic groups, cyclic groups, combinations of aliphatic and cyclic groups, silyl groups, alkyl halide groups, halides, organometallic groups, phosphorus groups, nitrogen groups, silicon, phosphorus, boron, germanium, or hydrogen;

wherein at least one substituent on (X^1) and (X^2) is a bridging group which connects (X^1) and (X^2);

wherein (X^3) and (X^4) are independently selected from halides, aliphatic groups, substituted aliphatic groups, cyclic groups, substituted cyclic groups, combinations of aliphatic groups and cyclic groups, combinations of substituted aliphatic groups and cyclic groups, combinations of aliphatic groups and substituted cyclic groups, combinations of substituted aliphatic groups and substituted cyclic groups, amido groups, substituted amido groups, phosphido groups, substituted phosphido groups, alkyloxide groups, substituted alkyloxide groups, aryloxide groups, substituted aryloxide groups, organometallic groups, or substituted organometallic groups; and

wherein the organoaluminum compound has the following general formula:

$$Al(X^5)_n(X^6)_{3-n}$$

wherein (X^5) is a hydrocarbyl having from 1-20 carbon atoms;

wherein (X^6) is a halide, hydride, or alkoxide; and

wherein "n" is a number from 1 to 3 inclusive.

14. (Previously presented) A process for producing a catalyst composition comprising simultaneously contacting a chlorided, zinc-containing alumina; propylene; at least one organometal compound selected from rac-dimethylsilybis (1-indenyl) zirconium dichloride, rac-1,2-ethanediylbis (1-indenyl) zirconium dichloride, or rac-dimethylsilybis (2-methyl-l-indenyl) zirconium dichloride; and at least one organoaluminum compound selected from triethylaluminum and triisobutylaluminum.

15. (Previously presented) A catalyst composition comprising a contact product of a catalyst precursor with at least one organometal compound and at least one organoaluminum compound;

wherein the catalyst precursor comprises at least one treated solid oxide compound and at least one alpha olefin;

wherein the at least one treated solid oxide comprises a contact product of at least one solid oxide compound, at least one electron-withdrawing anion source compound, and optionally, at least one metal salt compound;

wherein the organometal compound has the following general formula:

$$(X^1)(X^2)(X^3)(X^4)M^1$$

wherein M^1 is selected from titanium, zirconium, or hafnium;

wherein (X^1) and (X^2) are independently selected from cyclopentadienyls, indenyls, fluorenyls, substituted cyclopentadienyls, substituted indenyls, or substituted fluorenyls;

wherein substituents on the substituted cyclopentadienyls, substituted indenyls, and substituted fluorenyls of (X^1) and (X^2) are selected from aliphatic groups, cyclic groups, combinations of aliphatic and cyclic groups, silyl groups, alkyl halide groups, halides, organometallic groups, phosphorus groups, nitrogen groups, silicon, phosphorus, boron, germanium, or hydrogen;

wherein at least one substituent on (X^1) and (X^2) is a bridging group which connects (X^1) and (X^2);

wherein (X^3) and (X^4) are independently selected from halides, aliphatic groups, substituted aliphatic groups, cyclic groups, substituted cyclic groups, combinations of aliphatic groups and cyclic groups, combinations of substituted aliphatic groups and cyclic groups, combinations of aliphatic groups and substituted cyclic groups, combinations of substituted aliphatic groups and substituted cyclic groups, amido groups, substituted amido groups, phosphido groups, substituted phosphido groups, alkyloxide groups, substituted alkyloxide groups, aryloxide groups, substituted aryloxide groups, organometallic groups, or substituted organometallic groups; and

wherein the organoaluminum compound has the following general formula:

$$\mathbf{A1(X^5)_n(X^6)_{3-n}}$$

wherein (X^5) is a hydrocarbyl having from 1-20 carbon atoms;

wherein (X^6) is a halide, hydride, or alkoxide; and

wherein "n" is a number from 1 to 3 inclusive.

16. (Previously presented) A catalyst composition comprising a contact product of a catalyst precursor; at least one organometal compound selected from rac-dimethylsilybis (1-indenyl) zirconium dichloride, rac-1,2-ethanediylbis(1-indenyl)zirconium dichloride, or rac-dimethylsilybis (2-methyl-l-indenyl) zirconium dichloride; and at least one organoaluminum compound selected from triethylaluminum or triisobutylaluminum, the catalyst precursor comprising a chlorided, zinc-containing alumina and propylene.

17. (Previously presented) A catalyst composition comprising a contact product of at least one treated solid oxide compound, at least one organometal compound, at least one organoaluminum compound, and at least one alpha olefin;

wherein the at least one treated solid oxide compound comprises a contact product of at least one calcined solid oxide compound, at least one electron-withdrawing anion source compound, and optionally, at least one metal salt compound;

wherein the organometal compound has the following general formula:

$$(X^1)(X^2)(X^3)(X^4)M^1$$

wherein M^1 is selected from titanium, zirconium, or hafnium;

wherein (X^1) and (X^2) are independently selected from cyclopentadienyls, indenyls, fluorenyls, substituted cyclopentadienyls, substituted indenyls, or substituted fluorenyls;

wherein substituents on the substituted cyclopentadienyls, substituted indenyls, and substituted fluorenyls of (X^1) and (X^2) are selected from aliphatic groups, cyclic groups, combinations of aliphatic and cyclic groups, silyl groups, alkyl halide groups, halides, organometallic groups, phosphorus groups, nitrogen groups, silicon, phosphorus, boron, germanium, or hydrogen;

wherein at least one substituent on (X^1) and (X^2) is a bridging group which connects (X^1) and (X^2);

wherein (X^3) and (X^4) are independently selected from halides, aliphatic groups, substituted aliphatic groups, cyclic groups, substituted cyclic groups, combinations of aliphatic groups and cyclic groups, combinations of substituted aliphatic groups and cyclic groups, combinations of aliphatic groups and substituted cyclic groups, combinations of substituted aliphatic groups and substituted cyclic groups, amido groups, substituted amido groups, phosphido groups, substituted phosphido groups, alkyloxide groups, substituted alkyloxide groups, aryloxide groups, substituted aryloxide groups, organometallic groups, or substituted organometallic groups; and

wherein the organoaluminum compound has the following general formula:

$$Al(X^5)_n(X^6)_{3-n}$$

wherein (X^5) is a hydrocarbyl having from 1-20 carbon atoms;

wherein (X^6) is a halide, hydride, or alkoxide; and

wherein "n" is a number from 1 to 3 inclusive.

18. (Previously presented) A catalyst composition comprising a contact product of a chlorided, zinc-containing alumina; propylene; at least one organometal compound selected from rac-dimethylsilybis (1-indenyl) zirconium dichloride, rac-1,2-ethanediylbis (1-indenyl) zirconium dichloride, or rac-dimethylsilybis (2-methyl-l-indenyl) zirconium dichloride; and at least one organoaluminum compound selected from triethylaluminum and triisobutylaluminum.

19. (Previously presented) The catalyst composition according to Claim 15, wherein the catalyst composition has an activity greater than 500 grams of polypropylene per gram of treated solid oxide compound per hour under slurry polymerization conditions, using liquid propylene as a diluent, with a polymerization temperature of 70°C.

20. (Previously presented) The catalyst composition according to Claim 19, wherein the catalyst composition has an activity greater than 1000 grams of polypropylene per gram of treated solid oxide compound per hour under slurry polymerization conditions, using liquid propylene as a diluent, with a polymerization temperature of 70°C.

21. (Previously presented) The catalyst composition according to Claim 15, wherein a weight ratio of the organoaluminum compound to the treated solid oxide compound in the catalyst composition ranges from about 3:1 to about 1:100.

22. (Previously presented) The catalyst composition according to Claim 21, wherein the weight ratio of the organoaluminum compound to the treated solid oxide compound in the catalyst composition ranges from 1:1 to 1:50.

23. (Previously presented) The catalyst composition according to Claim 15, wherein a weight ratio of the treated solid oxide compound to the organometal compound in the catalyst composition ranges from about 1000:1 to about 10:1.

24. (Currently amended) The catalyst composition according to Claim 23, wherein ~~said~~ the weight ratio of the treated solid oxide compound to the organometal compound in the catalyst composition ranges from 250:1 to 20:1.

25. (Previously presented) The catalyst composition according to Claim 17, wherein the catalyst composition has an activity greater than 500 grams of polypropylene per gram of treated solid oxide compound per hour under slurry polymerization conditions, using liquid propylene as a diluent, with a polymerization temperature of 70°C.

26. (Previously presented) The catalyst composition according to Claim 25, wherein the catalyst composition has an activity greater than 1000 grams of polypropylene per gram of treated solid oxide compound per hour under slurry polymerization conditions, using liquid propylene as a diluent, with a polymerization temperature of 70°C.

27. (Previously presented) The catalyst composition according to Claim 17, wherein a weight ratio of the organoaluminum compound to the treated solid oxide compound in the catalyst composition ranges from about 3:1 to about 1:100.

28. (Previously presented) The catalyst composition according to Claim 27, wherein the weight ratio of the organoaluminum compound to the treated solid oxide compound in the catalyst composition ranges from 1:1 to 1:50.

29. (Previously presented) The catalyst composition according to Claim 17, wherein a weight ratio of the treated solid oxide compound to the organometal compound in the catalyst composition ranges from about 1000:1 to about 10:1.

30. (Previously presented) The catalyst composition according to Claim 29, wherein the weight ratio of the treated solid oxide compound to the organometal compound in the catalyst composition ranges from 250:1 to 20:1.

31. (Previously presented) A polymerization process comprising contacting the catalyst composition of Claim 15 and additional alpha olefin in a polymerization zone under polymerization conditions to produce a polymer.

32. (Previously presented) The process according to Claim 31, wherein the additional alpha olefin is propylene.

33. (Previously presented) The process according to Claim 31, wherein the additional alpha olefin is propylene and ethylene.

34. (Previously presented) The process according to Claim 31, wherein the polymerization conditions comprise slurry polymerization conditions.

35. (Previously presented) The process according to Claim 34, wherein the contacting is conducted in a loop reaction zone.

36. (Previously presented) The process according to Claim 35, wherein the contacting is conducted in the presence of a diluent that comprises, in major part, propylene.

37. (Previously presented) A polymerization process comprising contacting the catalyst composition of Claim 17 and additional alpha olefin in a polymerization zone under polymerization conditions to produce a polymer.

38. (Previously presented) The process according to Claim 37, wherein the additional alpha olefin is propylene.

39. (Previously presented) The process according to Claim 37, wherein the additional alpha olefin is propylene and ethylene.

40. (Previously presented) The process according to Claim 37, wherein the polymerization conditions comprise slurry polymerization conditions.

41. (Previously presented) The process according to Claim 40, wherein the contacting is conducted in a loop reaction zone.

42. (Previously presented) The process according to Claim 41, wherein the contacting is conducted in the presence of a diluent that comprises, in major part, propylene.

43. (Previously presented) A process to produce a polymer comprising substantially simultaneously contacting at least one organometal compound, at least one organoaluminum compound, at least one treated solid oxide compound, and at least one alpha olefin under polymerization conditions to produce the polymer;

wherein the organometal compound has the following general formula:

$$(X^1)(X^2)(X^3)(X^4)M^1$$

wherein M^1 is selected from titanium, zirconium, or hafnium;

wherein (X^1) and (X^2) are independently selected from cyclopentadienyls, indenyls, fluorenyls, substituted cyclopentadienyls, substituted indenyls, or substituted fluorenyls;

wherein substituents on the substituted cyclopentadienyls, substituted indenyls, and substituted fluorenyls of (X^1) and (X^2) are selected from aliphatic groups, cyclic groups, combinations of aliphatic and cyclic groups, silyl groups, alkyl halide groups, halides, organometallic groups, phosphorus groups, nitrogen groups, silicon, phosphorus, boron, germanium, or hydrogen;

wherein at least one substituent on (X^1) and (X^2) is a bridging group which connects (X^1) and (X^2);

wherein (X^3) and (X^4) are independently selected from halides, aliphatic groups, substituted aliphatic groups, cyclic groups, substituted cyclic groups, combinations of aliphatic groups and cyclic groups, combinations of substituted aliphatic groups and cyclic groups, combinations of aliphatic groups and substituted cyclic groups, combinations of substituted aliphatic groups and substituted cyclic groups, amido groups, substituted amido

groups, phosphido groups, substituted phosphido groups, alkyloxide groups, substituted alkyloxide groups, aryloxide groups, substituted aryloxide groups, organometallic groups, or substituted organometallic groups; and

wherein the organoaluminum compound has the following general formula:

$$Al(X^5)_n(X^6)_{3-n}$$

wherein (X^5) is a hydrocarbyl having from 1-20 carbon atoms;

wherein (X^6) is a halide, hydride, or alkoxide;

wherein "n" is a number from 1 to 3 inclusive; and

wherein the treated solid oxide compound is produced by a process comprising: a) contacting at least one solid oxide compound with at least one electron-withdrawing anion source compound; b) optionally, also contacting the solid oxide compound with at least one metal salt compound; and c) calcining the solid oxide compound before, during, or after contacting the electron-withdrawing anion source compound or the metal salt compound to produce the treated solid oxide compound.

44. (Previously presented) The process according to Claim 43, wherein the at least one alpha olefin is propylene.

45. (Previously presented) The process according to Claim 43, wherein the at least one alpha olefin is propylene and ethylene.

46-48. (Canceled).

49. (Previously presented) The process in accordance with Claim 11, wherein the at least one treated solid oxide compound comprises a calcined contact product of at least one solid oxide compound, at least one electron-withdrawing anion source compound, and optionally, at least one metal salt compound.

50. (Previously presented) The process in accordance with Claim 11, wherein the at least one solid oxide compound comprises at least one calcined solid oxide compound.

51. (Currently amended) A process to produce a catalyst composition comprising:

[[1)]] contacting a catalyst precursor with at least one organometal compound and at least one organoaluminum compound;

wherein the catalyst precursor comprises at least one treated solid oxide compound and at least one alpha olefin;

wherein the treated solid oxide compound is produced by a process comprising: a) contacting at least one solid oxide compound with at least one electron-withdrawing anion source compound; b) optionally, ~~also~~ contacting the solid oxide compound with at least one metal salt compound; and c) calcining the solid oxide compound before, during, or after contacting the electron-withdrawing anion source compound or the metal salt compound to produce the treated solid oxide compound;

wherein the organometal compound has the following general formula:

$$(X^1)(X^2)(X^3)(X^4)M^1$$

wherein M^1 is selected from titanium, zirconium, or hafnium;

wherein (X^1) and (X^2) are independently selected from cyclopentadienyls, indenyls, fluorenyls, substituted cyclopentadienyls, substituted indenyls, or substituted fluorenyls;

wherein substituents on the substituted cyclopentadienyls, substituted indenyls, and substituted fluorenyls of (X^1) and (X^2) are selected from aliphatic groups, cyclic groups, combinations of aliphatic and cyclic groups, silyl groups, alkyl halide groups, halides, organometallic groups, phosphorus groups, nitrogen groups, silicon, phosphorus, boron, germanium, or hydrogen;

wherein at least one substituent on (X^1) and (X^2) is a bridging group which connects (X^1) and (X^2);

wherein (X^3) and (X^4) are independently selected from halides, aliphatic groups, substituted aliphatic groups, cyclic groups, substituted cyclic groups, combinations of aliphatic groups and cyclic groups, combinations of substituted aliphatic groups and cyclic groups, combinations of aliphatic groups and substituted cyclic groups, combinations of substituted aliphatic groups and substituted cyclic groups, amido groups, substituted amido groups, phosphido groups, substituted phosphido groups, alkyloxide groups, substituted alkyloxide groups, aryloxide groups, substituted aryloxide groups, organometallic groups, or substituted organometallic groups; and

wherein the organoaluminum compound has the following general formula:

$$\mathbf{A1(X^5)_n(X^6)_{3-n}}$$

wherein (X^5) is a hydrocarbyl having from 1-20 carbon atoms;

wherein (X^6) is a halide, hydride, or alkoxide; and

wherein "n" is a number from 1 to 3 inclusive.

52. (Previously presented) The catalyst composition in accordance with Claim 15, wherein the at least one treated solid oxide compound comprises a calcined contact product of at least one solid oxide compound, at least one electron-withdrawing anion source compound, and optionally, at least one metal salt compound.

53. (Previously presented) The catalyst composition in accordance with Claim 15, wherein the at least one solid oxide compound comprises at least one calcined solid oxide compound.

54. (Currently amended) A process to produce a polymer comprising contacting the catalyst composition obtained by the process of Claim 51 and additional alpha olefin in a polymerization zone under polymerization conditions to produce a polymer.

55. (Previously presented) The process according to Claim 54, wherein the additional alpha olefin is propylene.

56. (Previously presented) The process according to Claim 54, wherein the additional alpha olefin is propylene and ethylene.

57. (Previously presented) The process according to Claim 54, wherein the polymerization conditions comprise slurry polymerization conditions.

58. (Previously presented) The process according to Claim 54, wherein the contacting is conducted in a loop reaction zone.

59. (Previously presented) The process according to Claim 54, wherein the contacting is conducted in the presence of a diluent that comprises, in major part, propylene.